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Things to know about tetanus

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ABSTRACT

Tetanus is a disease of the nervous system characterised by muscle spasms caused by toxins produced by an anaerobic bacterium called *Clostridium tetani* (*C. tetani*) found in soil. These muscle spasms may occur frequently in the jaw and neck but may also be generalised throughout the body. The diagnosis can be made clinically and by history. The causative agent of tetanus, *C. tetani*, produces toxins that trigger muscle contractions after contamination from saliva, faeces, contaminated products and soil. Tetanus is a disease that can be prevented by vaccination. In case of a possible tetanus risk in the patient, tetanus prophylaxis planned according to the type of injury after cleaning the wound prevents the disease.

Keywords: Tetanus, *Clostridium tetani*, diagnosis, treatment

EPIDEMIOLOGY

A significant decrease has been observed in adult and neonatal tetanus cases over the years with the vaccination of children within the scope of the Expanded Immunisation Programme implemented in our country, women in the 15-49 age group and pregnant women and military personnel within the scope of the Maternal Neonatal Tetanus Elimination Programme.[1] When the tetanus cases in our country are analysed, while a total of 550 cases were observed between 1980-1984, 77 cases were detected between 2013-2017. Although there is no data for 2018 in the records of the World Health Organization (WHO) for our country, a total of 18 cases were observed in 2019 and all of them were adult tetanus cases.[2] It was announced by WHO on 24 April 2009 that maternal and neonatal tetanus was eliminated in Turkiye. When neonatal tetanus cases were analysed between 2009 and 2019, two cases were observed in 2010 and one case was observed in 2014.[3]

PATHOGENESIS

Clostridium tetani (C. tetani) enters the human body through injuries that cause disruption of skin integrity. Infections that occur in the neonatal period usually occur as a result of umbilical cord procedures or transmission through the umbilical cord.

When anaerobic conditions are provided for the settling spores, they transform into a vegetative form. The bacteria begin to produce toxins that are spread throughout the body by blood and lymphatic flow. The toxins are retained and act in various parts of the central nervous system, including the motor endplate, spinal cord and brain. It is effective in the sympathetic nervous system.

Tetanus toxin disrupts the neurotransmitter balance, disabling inhibitory mechanisms and leading to clinical symptoms.[4] This leads to muscle contractions and spasms. In addition to these, seizures may be observed, and different findings may occur due to the involvement of the autonomic nervous system.[5]

Tetanospasmin toxin synthesised by *C. tetani* is a very potent neurotoxin.[6] Tetanus toxin spreads from tissue spaces to lymphatic and vascular systems. It enters the nervous system through neuromuscular junctions and is transported to the central nervous system by retrograde axonal transport.[7]

TYPES OF CLINICS

Tetanus manifests itself with four different clinical types;[8]

A) Generalised tetanus

B) Localised tetanus

C) Cephalic tetanus

D) Neonatal tetanus

A) Generalised Tetanus

50-75% of patients present with a generalised form:[8]

-The first symptom is usually trismus or locking of the jaw. Locking in the jaw area is seen due to contractions in the masseter muscle.

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-In the following period, stiffness in the neck area, difficulty in swallowing and hardening in the abdomen are observed. In addition to these, findings such as increase in temperature, sweating, increase in blood pressure, tachycardia are observed.

-Nuchal rigidity and dysphagia, condescending smile (risus sardonicus) are among the early findings of facial involvement.

-Spasms may recur frequently and may last up to a few minutes.

-Spasms may last for three to four weeks.

-Curative recovery may take months in patients.

B) Localised Tetanus

In localised forms, patients have persistent spasm of a group of muscles:[8]

-The underlying pathology is a dysfunction of the intermediate neurons that inhibit alpha neurones.

-There is no involvement of the central nervous system and therefore mortality is low.

C) Cephalic Tetanus Is a Rare Form

The features of this form are given below.[2,8]

-It usually occurs after head trauma or otitis media.

-Presentations are seen due to cranial nerve involvement.

-Infection may remain localised or may show a tendency to spread.[2]

D) Neonatal Tetanus

Another form of tetanus which is rare in developed countries and frequently results in neonatal death in undeveloped countries:[8,9]

-The infection starts with the involvement of the contaminated umbilical cord during delivery in unsanitary and unhygienic environments and progresses due to inadequate maternal immunisation.

-In the first week after birth, the baby becomes restless, feeding decreases and spasm attacks occur.

-The prognosis is poor in neonatal babies.

PHYSICAL EXAMINATION FINDINGS

-The first symptoms of tetanus are headache and muscle stiffness. It starts especially in the jaw region, spasm in the neck region, difficulty in swallowing, abdominal findings, generalised spasms and sweating are other findings.

-Fever is not detected in patients and consciousness is clear.[10]

-Spatula test may be performed in patients. The spatula test is a simple diagnostic bedside test involving touching the oropharynx with a spatula. Under normal conditions, this manoeuvre causes a gag reflex, and the patient tries to remove the spatula (i.e., a negative test result). However, if the patient has tetanus, they may develop a reflex spasm and bite the spatula (positive test result). The sensitivity and specificity of this test have been found to be 94% and 100%, respectively.[11]

-Opistotonus develops in patients as a result of contraction. While flexion is observed in the arms, extension movement is observed in the feet, periodic apnoea attacks are observed as a result of contraction of intercostal muscles and diaphragm. Rigidity may be observed in the abdominal wall.[10]

-Autonomic dysfunction is observed in the late stages of the disease. In addition to hypertension and tachycardia, hypotension and bradycardia and cardiac arrest may be observed.

-Sudden tonic contractions and tetanic seizures resembling epileptic seizures may be observed. There is no loss of consciousness during these seizures. Severe pain usually occurs. The occurrence of these seizures indicates a poor prognosis. In seizures, opistotonus state, deflection and abduction of the upper extremities and extensor movements in the lower extremities are observed.

-Abdominal contractions may mimic acute abdominal findings and patients may present to hospital with these findings. Tenderness and defence in the abdomen may be observed. It has been observed that laparotomy is performed in patients who are not diagnosed correctly.

DIAGNOSIS

The points to be considered in the diagnosis are as follows: [12]

-There is no special test for the diagnosis, the diagnosis is made under detailed anamnesis and clinical observation.

-Trismus, dysphagia, generalised rigidity and muscle spasms are among the findings that should be observed for clinical diagnosis.

-No significant changes were observed in complete blood count and biochemical values.

-Cerebrospinal fluid obtained by lumbar puncture was normal.

-No diagnostic change is observed.

-Serum muscle enzymes, especially enzymes such as creatine phosphokinase, may be increased.[12]

TREATMENT

The most successful intervention against tetanus is prevention with vaccination. Tetanus cases may show a mortal course. Developments in intensive care units, close monitoring of patients, certain pharmacological treatments have increased survival rates.

Treatment goals:[13]

1. Inhibition of toxin production

2. Neutralisation of free toxins

3. General supportive therapy: Airway control, control of muscle spasm, management of autonomic disorders

1. Inhibition of Toxin Production

Approaches for toxin inhibition are given below:[14]

- Wound control is important to prevent toxin production.
- The spores in the wound should be eradicated, necrotic tissue should be debrided and the wound site should be cleaned.
- Another important point for inhibiting toxin production is antibiotherapy.
- Appropriate antimicrobial therapy after appropriate debridement is an important factor in the eradication of *C. tetani.*
- Metronidazole 500 mg every 6-8 hours and penicillin-G 2-4 million units every 6 hours.
- In patients who do not respond to treatment, trimethoprium-sulfamethoxazole is used.[14]

2. Neutralisation of Free Toxins

Approaches for toxin neutralization are given below:[15]

- Human tetanus immunoglobulin (TIG) is an antiserum used for neutralisation of toxins.
- Although the optimal therapeutic dose is not clear, 500 units is recommended.
- It can be given up to 3000 to 6000 units when necessary.
- Half of the dose is administered around the wound as soon as tetanus is diagnosed.The other half is given as intramuscular administration.

3. General Supportive Therapy

Approaches for general supportive therapy are given below:[16]

- Diffuse muscle contractions may be life-threatening due to respiratory system failure, aspiration and exhaustion.
- The presence of the patient in a quiet and dark room without light will prevent the occurrence of muscle spasms. Benzodiazepines are traditionally used drugs which are effective against rigidity and muscle spasms.[14] The most commonly used benzodiazepine is diazepam. Diazepam is used intravenously with an initial dose of 10-30 mg. Anaesthesia may be used to relieve spasms in patients who develop tolerance to benzodiazepine administration. Propofol infusion provides control of spasm and rigidity. Neuromuscular agents are used when sedation is inadequate. Vekorunium and other blockers without cardiovascular effects are preferred. Neuromuscular blockers are usually administered as continuous infusion. Baclofen acts by stimulating postsynaptic GABA (gamma amino buturic acid) beta receptors. The preferred route is intrathecal. It can be given as bolus or by continuous intrathecal infusion at a dose of 1000 mcg.[16]

VACCINATION IN TETANUS PROPHYLAXIS

-According to the recommendation made by the American Advisory Committee on Immunisation Practices (ACIP), diphtheria, tetanus and acellular pertussis vaccines should be administered in newborns at the 2nd, 4th and 6th months, and the 4th and 5th doses should be administered at the 18th month and 4-6 years of age.[17]

-A booster dose for tetanus and diphtheria is recommended every ten years for correctly vaccinated individuals.[17] In our country, circulars of the Ministry of Health and recommendations of the adult vaccination guide are in this direction.

TETANUS IMMUNISATION IN OUR COUNTRY

The vaccination schedule applied in our country as of 2020; it is applied as diphtheria, acellular pertussis and tetanus administered at the end of the 2nd, 4th, and 6th months. It is administered as a quintuple mixed vaccine with inactivated polio (IPV) and Haemophilus influenzae type B. The booster of the quintuple mixed vaccine is administered again in the 18th month. Quadrivalent combination vaccine with DaBT and IPV is administered at 48 months. Adult diphtheria and tetanus vaccine (Td) is administered at the age of 13.[18]

TETANUS VACCINE INDICATIONS AND APPLICATION METHODS

Indications and method of application are as follows:[19]

-It is recommended to be routinely administered in childhood.

-It is recommended to complete the vaccination of individuals who have not been vaccinated or have not been vaccinated during childhood.

-Primary vaccination in the adult period is three doses. Vaccination is performed as two doses at four-week intervals and the third dose 6 months after the second dose. If the third dose is not administered on time, it can be administered up to 12 months after the first dose.

-Since the antitoxin level decreases over the years, a booster dose is administered every 10 years in adults. It is recommended that one of these booster doses should be tetanus-diphtheria-inactivated polio (Tdap).

-Tetanus vaccine is administered to people who have not been previously vaccinated or whose previous vaccination status is unknown.

-In pregnancy, every pregnant woman is vaccinated, regardless of her vaccination status. If possible, it is recommended to administer one dose as Tdap. The most appropriate period for vaccination is 27-36 weeks of pregnancy.

-Tetanus vaccine is recommended for all healthcare workers who have not been vaccinated against tetanus before and who have the possibility of contact with infants younger than 12 months.

CONTRAINDICATIONS OF THE VACCINE

Vaccination is contraindicated in patients with severe allergic reactions after vaccination and in case of development of neurological symptoms after vaccination. In periods of moderate and severe acute illness, vaccination can be postponed until the patient recovers. Mild illnesses and breastfeeding are not contraindications for vaccination.[19]

SIDE EFFECTS OF THE VACCINE

- Common side effects of the vaccine after application are pain, erythema and swelling.
- It is seen to be more common locally, especially at the application site.
- Arthus, which is called local oversized pieces, may occur. This situation does not constitute a contraindication for the vaccine.[19]

POST-EXPOSURE PROPHYLAXIS

After the injury, immunoglobulin and vaccine should be administered according to the contamination status of the wound and the patient's vaccination calendar (Table).[19]

1. Clean Wounds:

a. Surgical incisions

b. Injuries treated within 2 hours

2. Dirty Wounds:

a. Contaminated with dirt, faeces, soil or saliva

b. Cut wounds

c. Fragmentation wounds

d. Bruise wounds

e. Puncture wounds

f. Frostbite and burn wounds

g. Patients treated within 12 hours of injury

Table. Post-contact prophylaxis

Immunisation status	Clean minor injuries		Other injuries (dirty, faecal-saliva contact, incision, burn, foreign body)	
	Vaccine	Immunoglobulin	Vaccine	Immunoglobulin
Unknown or <3 doses	Yes	No	Yes	Yes
>3 doses	No (*)	No	No (**)	No
*It is administered if the last dose is >10 years.				
**It is administered if the last dose is >5 years.				
The immunoglobulin administered for prophylaxis is 250 IU.				

Where human tetanus immunoglobulin is not available, heterelog serum is used and 3000-5000 IU can be administered intramuscularly.

CONCLUSION

Tetanus is a nervous system disease characterised by muscle spasms caused by tetanospasmin toxin, a potent neurotoxin produced by an anaerobic bacterium called *C. tetani* found in soil. *C. tetani* enters the human body through injuries that cause disruption of skin integrity. There is no specific test for diagnosis, the diagnosis is made under detailed anamnesis and clinical observation. Trismus, dysphagia, generalised rigidity and muscle spasms are among the findings that should be observed for clinical diagnosis. Wound control is important to prevent toxin production. The spores in the wound should be eradicated, necrotic tissue should be debrided, and the wound site should be cleaned. The most successful intervention against tetanus is prevention with vaccination.

ETHICAL DECLARATIONS

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

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Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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